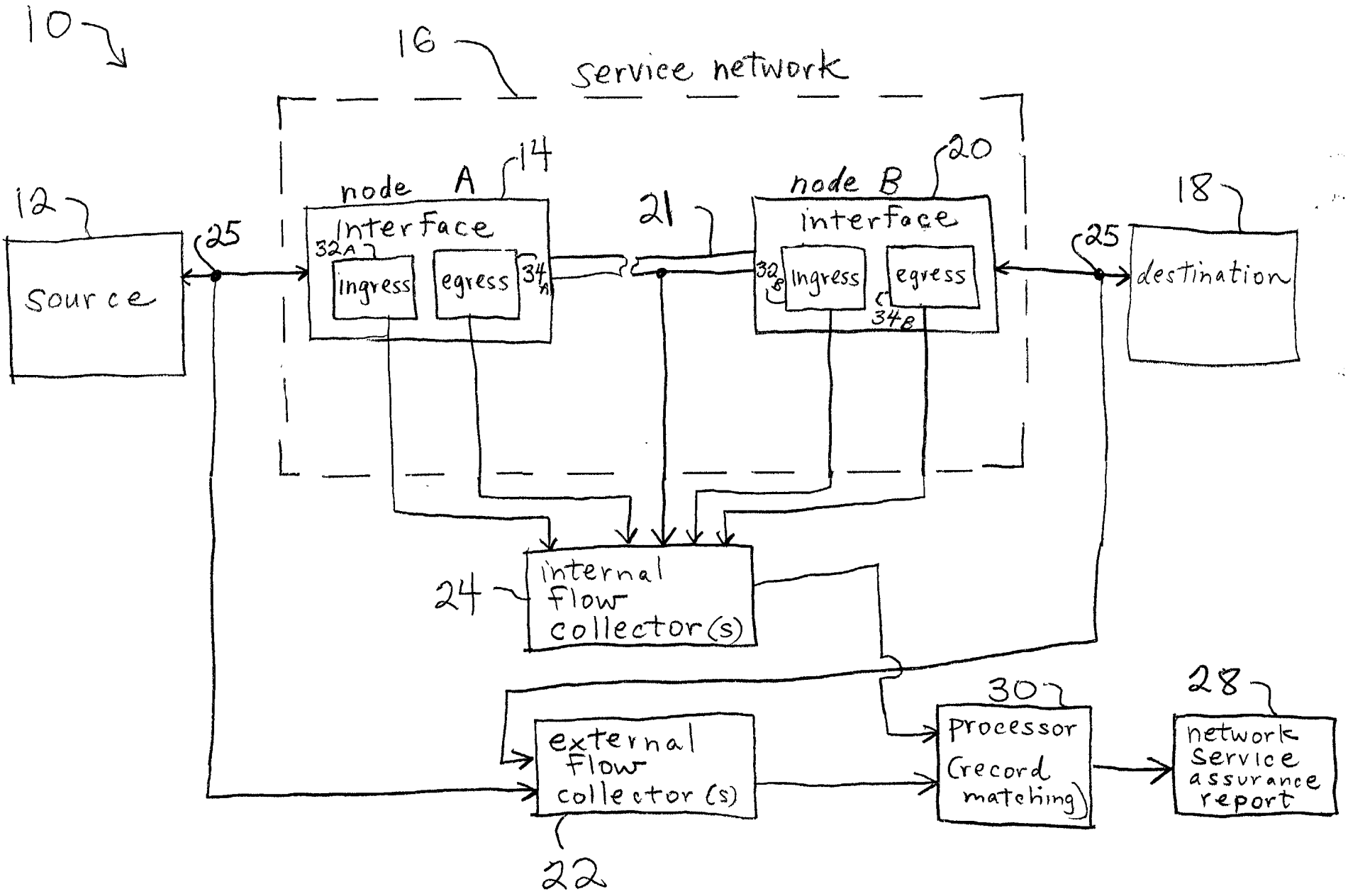
FIG. 1



26 ↘ time stamp data — Flow activity records

start time	end time or duration	Flow descriptor	Performance metrics
t_1		fd_1	pm_1
t_2		fd_2	pm_2
⋮		⋮	⋮
t_n		fd_n	pm_n

FIG 2
(PRIOR ART)

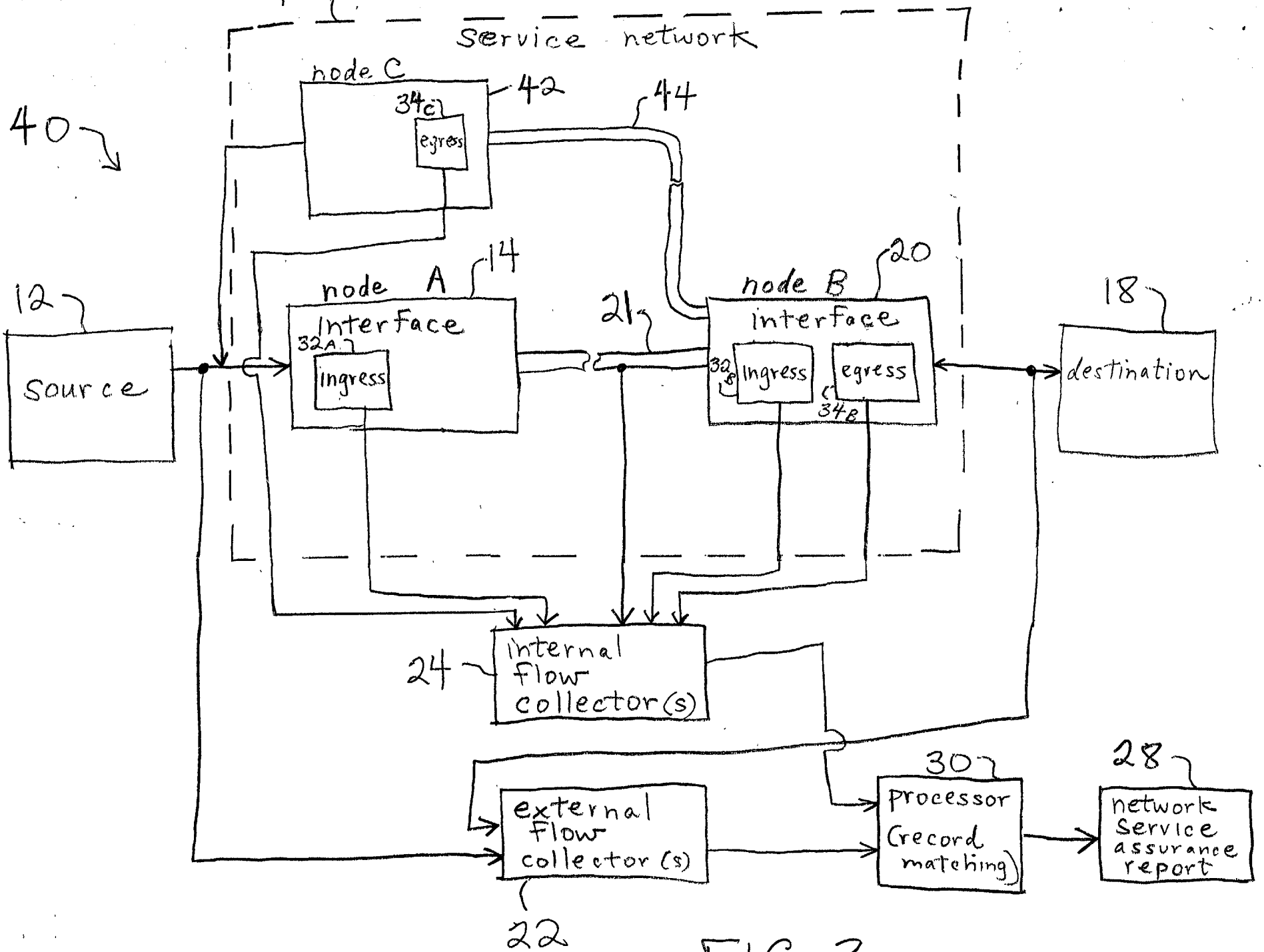


FIG. 3

Example (all for fd_1)	external flow collector (total packets)	internal flow collector (total packets)		external flow collector (total packets)	data analysis
	source egress	service network ingress	service network egress	destination ingress	
1	14	14	14	14	no loss
2	10	10	9	9	loss in service network
3	10	9	9	9	loss outside of service network
4	14	11	10	10	loss inside and outside of service network
5	10	5	10	10	loss outside of service network with alternate path into service network
6	10	5	5	10	loss outside of service network with alternate path around service network

FIG. 4

external flow collector (sequence number)		internal flow collector (sequence number)	
source egress	destination ingress	service network ingress Example 1	service network ingress Example 2
10001	10001	10001	10001
10002	10002		10002
10003	10003	10003	
10004	10004		
10005	10005	10005	10005
10006	10006		10006
10007	10007	10007	
10008	10008		
10009	10009	10009	10009
10010	10010		10010
Diagnosis		round-robin load balancing	load balancing

FIG. 5

Example	external flow collector	internal Flow collector		external flow collector	Destination reachable?
	source egress	service network ingress	service network egress	destin. ingress	
1	Fd_1	Fd_1	fd_1	fd_1	Yes
2	Fd_1	fd_1	Fd_1	no fd_1	No
3	Fd_1	Fd_1	no fd_1	no fd_1	No
4	Fd_1	no fd_1	no fd_1	no fd_1	No
5	Fd_1	no fd_1	no fd_1	fd_1	Yes

FIG. 6

Example	external Flow collector	internal flow collector	Connectivity ?
	source	service network	
1	Fd_1 (i, e)	fd_1 (i, e)	Yes
2	Fd_1 (no i, e)	Fd_1 (i, no e)	No
3	Fd_1 (no i, e)	fd_1 (i, e)	No

FIG. 7

FIG. 8A

Network Round-Trip Delay From Matched Flow Records

Specific Calculation	Description	Method
RTT_1	Total Network Delay ($dT_1 + dT_2 + dT_3$)	(Time Duration(FR_{E1}) – Time Duration(FR_{E2})
RTT_2	Non Remote Network Delay ($dT_1 + dT_2$)	(Time Duration(FR_{E1}) – Time Duration(FR_{I2})
RTT_3	Non Local Network Delay ($dT_2 + dT_3$)	(Time Duration(FR_{I1}) – Time Duration(FR_{E2})
RTT_4	Local Network Delay (dT_1)	(Time Duration(FR_{E1}) – Time Duration(FR_{I1})
RTT_5	Service Network Delay (dT_2)	(Time Duration(FR_{I1}) – Time Duration(FR_{I2})
RTT_6	Remote Network Delay (dT_3)	(Time Duration(FR_{I2}) – Time Duration(FR_{E2})

$TimeDuration(FR_x) = FR_{LastTime}^{*} - FR_{StartTime}^{\dagger}$

$TimeDuration(FR_x) = FR_{Duration}$

† Time represents the timestamp of the first packet transmitted from the source to the destination.

* Time represents the timestamp of the last packet transmitted from the destination to the source.

FIG. 8B

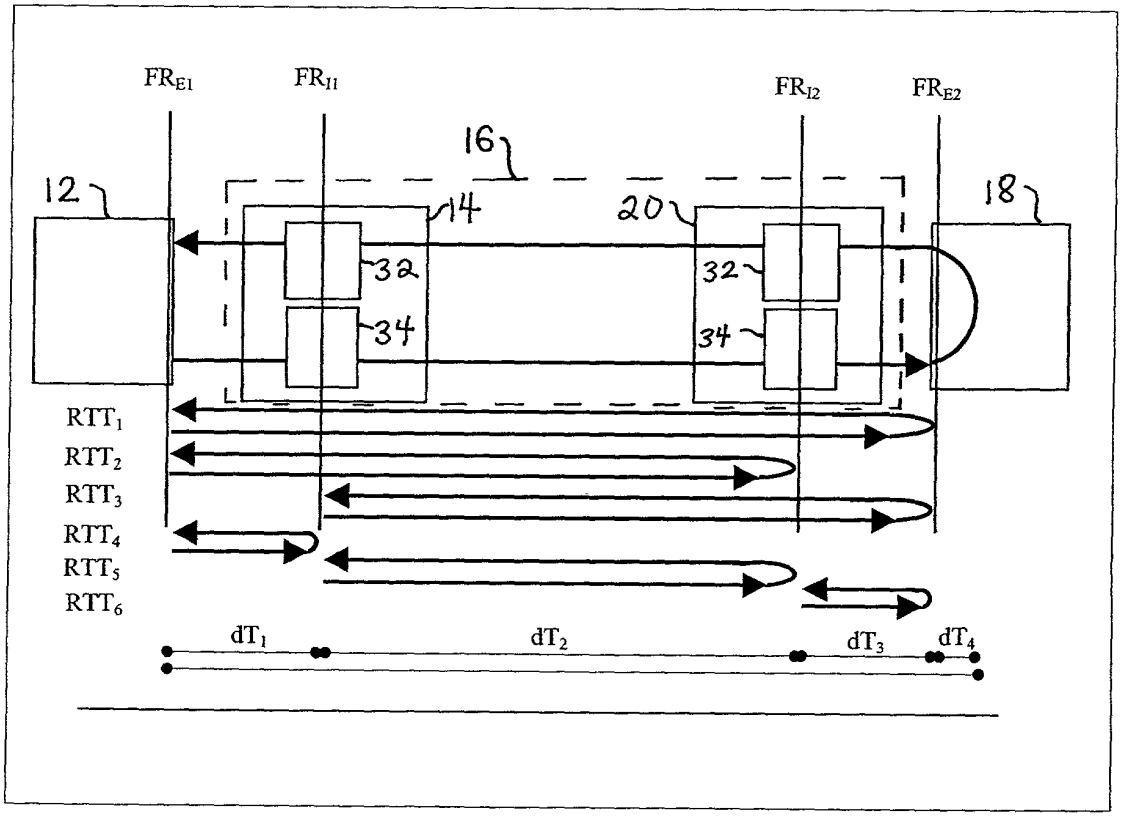


FIG. 9A

One-Way Delay Determination From Matched Flow Records

Specific Calculation	Description	Method
OWD_1	Local Network Egress Delay	(StartTime(FR_{I1}) – StartTime(FR_{E1})
OWD_2	Service Network Ingress Delay	(StartTime(FR_{I2}) – StartTime(FR_{I1})
OWD_3	Remote Network Ingress Delay	(StartTime(FR_{E2}) – StartTime(FR_{I2})
OWD_4	Remote Network Egress Delay	(LastTime(FR_{I2}) – LastTime(FR_{E2})
OWD_5	Service Network Egress Delay	(LastTime(FR_{I1}) – LastTime(FR_{I2})
OWD_6	Local Network Ingress Delay	(LastTime(FR_{E1}) – LastTime(FR_{I1})

$StartTime(FR_x) = FR_{StartTime}^{\dagger}$
$LastTime(FR_x) = FR_{LastTime}^{*}$
$LastTime(FR_x) = FR_{StartTime}^{\dagger} + FR_{Duration}^{*}$

† Time represents the timestamp of the first packet transmitted from the source to the destination.
* Time represents the timestamp of the last packet transmitted from the destination to the source.

FIG. 9B